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ARMSTRONG LABORATORY

ARMSTRONG LABORATORY'S PARTICIPATION IN THE WARFIGHTER95 TECHNICAL INTEGRATION EVALUATION: A SUMMARY REPORT

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This report describes the participation of Armstrong Laboratory's Aircrew Training Research Division in the Warfighter95 (WF95) Technical Integration Evalution (TIE) which was held 4 and 5 December 1995. Other participants included representatives from the Air Force, Army, and Navy. The TIE had three main objectives: (a) to test the WP95 architecture, including connectivity issues and the merging of multiple simulations; (b) to evaluate the enhancements offered by advanced distributed simulation technology; including linking operational and tactical levels of simulation and using simulation to drive real-world systems; and (c) to record lessons learned. The nine participating sites were located throughout the continental United States, and were interconnected via a communications network. the WF95 TIE resulted in several significant technological achievements, including upgrading the Air Warfare Simulation (AWSIM) constructive simulation to be compatible with Distributed Interactive Simulation (DIS) protocols and stimulating command and control equipment with simulation data.

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PREFACE

This report summarizes the participation of Armstrong Laboratory's Aircrew Training Research Division (AL/HRA) in the Warfighter95 (WF95) Technical Integration Evaluation (TIE).

This work was conducted under Work Unit 2743-25-27, Low Cost, High Fidelity Plural Use Access Tools or Synthetic Environments for Air Warriors. The effort is part of AL/HRA's Multiship Research and Development (MULTIRAD) program. The work unit monitor and principal investigator was Capt Robert J. Clasen, AL/HRAE.

Armstrong Laboratory's Participation in the Warfighter95 Technical Integration Evaluation: A Summary Report

INTRODUCTION

Armstrong Laboratory's Aircrew Training Research Division (AL/HRA), located at Williams Gateway Airport in Mesa, AZ, participated in the Warfighter95 (WF95) Technical Integration Evaluation (TIE) which took place 4-5 Dec 95. The primary purpose of the WF95 TIE was to evaluate a distributed simulation architecture that could be used to train battlestaffs, command and control elements, and crewmembers. This report describes the WF95 program, summarizes Armstrong Laboratory's participation in WF95, and documents lessons learned.

WARFIGHTER95 PROGRAM DESCRIPTION

This section provides an overview of the WF95 program. It gives background, lists the participating sites, describes network connectivity, and summarizes the major results of the WF95 TIE.

Overview

The WF95 TIE took place 4-5 Dec 95. This event was the first major application of advanced distributed simulation (ADS) technology for Joint Force Air Component Commander (JFACC) team training.

The USAF Air Warfare Center was tasked by Headquarters, Air Combat Command (HQ ACC) to conduct the WF95 TIE. Additional program management was provided by HQ Air Force (AF/XOM). The operational lead agency was the USAF Battlestaff Training School (BTS) located at Hurlburt Field, FL, and the technical lead

agency was the Theater Air Command and Control Simulation Facility (TACCSF) located at Kirtland AFB, NM.

Background

WF95 was originally planned as an ADS exercise in conjunction with the annual Chief of Staff of the Air Force and Chief of Staff of the Army Warfighter Talks. The purpose of WF95 was to build an ADS environment which merged constructive (computer-modeled) simulation, virtual (man-in-the-loop) simulators and live fly aircraft to exercise battlestaffs, subordinate command and control (C2) elements, and crewmembers. WF95 requirements included a real-time, accurate, battlespace picture in the Joint Air Operations Center (JAOC) via Tactical Digital Information Link (TADIL) and Tactical Information Broadcast System (TIBS), both driven by simulation. WF95 was based on a Korean scenario developed for a previous Blue Flag exercise.

Due to the federal government shutdown in Nov 95, the scope of WF95 was reduced from an operational exercise to a technical evaluation. The TIE had three main objectives. The first was to test the WF95 architecture, including connectivity issues and the merging of multiple simulations. The second was to evaluate the enhancements offered by ADS technology, including linking operational and tactical levels of simulation and using simulation to drive real-world systems. The third objective was to record lessons learned.

Participants

Participants in the WF95 TIE provided constructive, virtual, or live simulation entities, or they used simulation inputs to drive real-world displays. These participants included representatives from the Air Force, Army, and Navy. A listing of WF95 TIE participants is given in Table 1.

Table 1. List of WF95 Participating Sites

Organization	Location	Provided
Theater Air Command and Control Simulation Facility (TACCSF) - Air Force	Kirtland AFB, NM	- Constructive air and land forces - Virtual F-15C - AWACS simulation - Patriot missile simulation - JSTARS simulation
USAF Battlestaff Training School (BTS) - Air Force	Hurlburt Field, FL	- Constructive air and land forces - Command and control center
728 Air Control Squadron - Air Force	Hurlburt Field, FL	- Control and Reporting Center
Theater Battle Arena (TBA) - Air Force	Washington, DC (Pentagon)	- Constructive air and land forces - Virtual F-15C - Virtual F-15E - Cobra Ball simulation - JSTARS simulation
Armstrong Laboratory (AL/HRA) - Air Force	Mesa, AZ	- Virtual F-16Cs
Range Application Joint Program Office (RAJPO) - Air Force	Eglin AFB, FL	- Live aircraft F-16C
Information Warfare Center (IWC) - Air Force	Kelly AFB, TX	- Rivet Joint simulation (RC-135) - Provided TIBS data feed to BTS
Aviation Test Bed (AVTB) - Army	Fort Rucker, AL	- Virtual AH-64
What-If Simulation Systems for Advanced Research Development (WISSARD) - Navy	Norfolk, VA	- Virtual F-14 - Virtual F/A-18

WF95 Network

The nine participating sites were located throughout the continental United States, and the sites were interconnected via a communication network. This network consisted of high-capacity T1 telephone connections among the Air Force sites. The Army and

Navy sites used the Defense Simulation Internet (DSI) to connect to TACCSF and, thus, to the rest of the Air Force network. Figure 1 shows the geographic layout of the WF95 network.

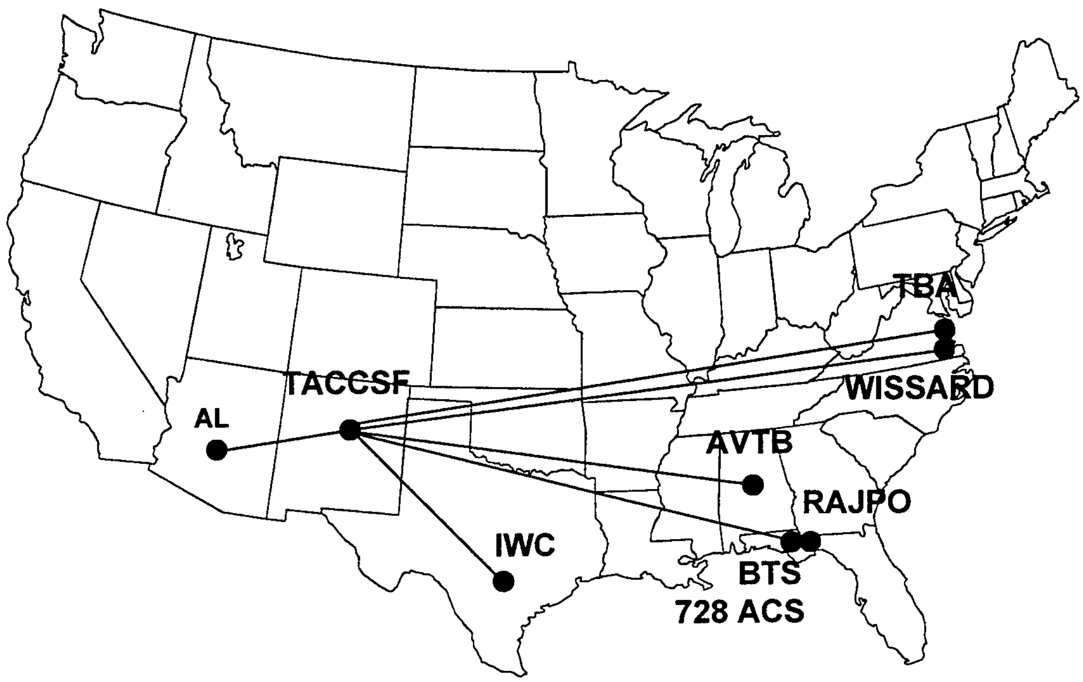

Figure 1. Warfighter95 Network

Both simulation data and voice communication were transmitted over this network. Voice transmissions were digitized before being sent over the network. All network traffic used Distributed Interactive Simulation (DIS) protocols, version 2.0.4.

WF95 TIE Results

WF95 linked the JAOC to subordinate C2 nodes and crewmembers. This allowed two-way, real-time interaction of data and voice communications from many sites. The

TIE successfully captured baseline capabilities and limitations. Some significant WF95 contributions are outlined below:

- The Air Warfare Simulation (AWSIM) system located at BTS was upgraded to be compliant with DIS standards. This DIS capability allows person-in-the-loop participation, which adds realism to battlestaff training conducted at BTS.

- Simulation data stimulated subordinate C2 nodes using standard data links (i.e., TADIL and TIBS). In WF95, the following C2 elements were successfully linked:

a live Control and Reporting Center (CRC)
a virtual Airborne Warning and Control System (AWACS)
a virtual Cobra Ball
a virtual Joint Surveillance Target Attack Radar System (JSTARS)
a constructive Rivet Joint.

Data from these nodes were included in the TADIL network and on TIBS and were displayed in the JAOC on an Air Defense Systems Integrator.

- WF95 voice communication was the most extensive test of digital voice to date. WF95 overlayed digitized voice with simulation data on a single T-1 circuit to explore the bandwidth limitations and compatibility of varied DIS voice systems. For the TIE, digital voice was used for exercise control and tactical communication among all participants. Future ADS exercises can minimize their tactical communications requirements by building upon WF95 experience.

- WF95 successfully integrated virtual cockpits into the execution of a realistic Air Tasking Order with AWACS and CRC control provided by operational crews. In addition, two live F-16Cs flying over the Eglin AFB range were integrated into the scenario. The virtual cockpits were able to interact via radar and visually with all constructive targets, other virtual cockpits, and live fly aircraft. This offers tremendous training potential at many different levels: from battlestaffs to subordinate C2 units to crewmembers.

AL/HRA'S PARTICIPATION IN WF95

This section summarizes AL/HRA's participation in the WF95 TIE. It describes the system configuration, the engineering development effort, and the missions flown to support the TIE.

System Configuration

AL/HRA provided two high-fidelity F-16C Weapon Systems Trainers (WSTs) for WF95. In addition, we used our Multiship Support Station (MSS) to display the ongoing scenario and to monitor network traffic.

The F-16 WST was developed by AL/HRA as an inexpensive training device that offers full fidelity and systems concurrency with the actual aircraft. The WST can be used for emergency procedures training in a stand-alone mode, or when networked with other simulation devices (as during WF95), it can be used for team training exercises and tactics. To support both air-to-air and air-to-ground missions, the WST was configured with the following weapons for WF95: AIM-9 missiles, AIM-120 missiles, and Mk-82 bombs. Visual imagery for the cockpit was provided by the Advanced Visual Technology System (AVTS) image generator. The visual images were displayed on flat-screened domes that enveloped the cockpit. These domes, based on AL-developed Display for Advanced Research and Technology (DART) technology, provided the pilots with 360° horizontal by 260° vertical field of regard.

The MSS allowed managers and technicians to monitor proceedings during the TIE. Its displays provided information on the status of the F-16 WSTs and the status of other sites connected to the WF95 network. It also gave a god's-eye view of the entire ongoing scenario overlaid on a map of Korea. In addition, we used the MSS to initialize (e.g., weapons loads, fuel, location) the cockpits before each mission.

Figure 2 shows a schematic overview of the system configuration AL/HRA used for WF95. Note that since the evaluation was classified SECRET, we used KG-194

encryption devices to protect classified simulation data before sending it out of our facility to TACCSF.

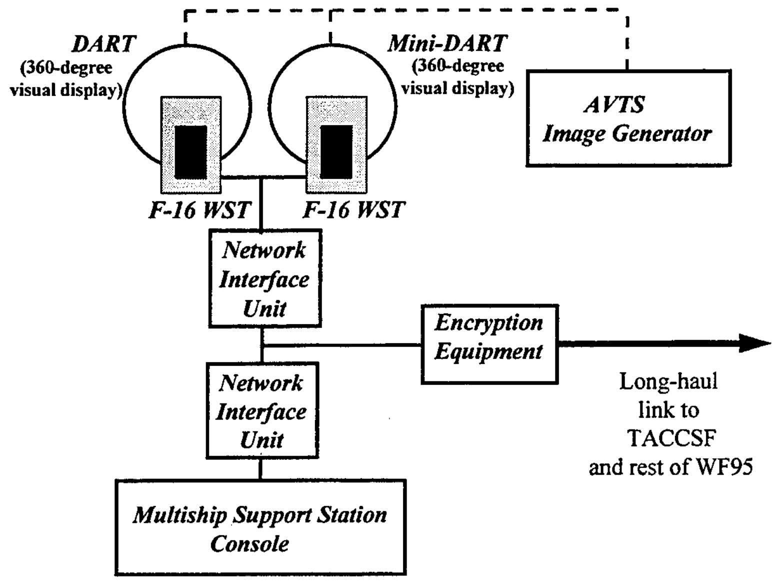

Figure 2. AL/HRA System Configuration

Engineering Effort

Though the majority of resources needed for AL/HRA to support the WF95 TIE were already in place, there was still a significant amount of engineering development required. AL/HRA's engineering effort can be broken down into four main areas: networking, establishing digital voice communication, database development, and testing.

Networking

In order to establish connectivity and data communication among the distributed sites, we first had to install a T-1 phone link between AL/HRA and TACCSF, and then we had to upgrade our Network Interface Units (NIUs) to be compatible with DIS Standard 2.0.4.

The T-1 is a high-bandwidth phone line that distributed the simulation data and voice communication data among all WF95 sites. Since this data contained potentially SECRET information, the entire WF95 network was classified at that level. KG-194s were used to encrypt the data at both ends of our T-1 link with TACCSF. As technical lead for WF95, TACCSF provided preconfigured equipment (e.g., network bridges, KG-194s, etc.) for installation at AL/HRA's end of the T-1 connection.

After installing the T-1 line, we needed to modify the NIUs for the F-16 WSTs and the MSS to adhere to DIS Standard 2.0.4. DIS protocols allow different simulation devices to communicate with each other, and all WF95 sites used the DIS 2.0.4 standard for communication. Our NIUs previously complied with DIS 2.0.3, and the changes required for upgrading to DIS 2.0.4 were easily implemented. Only a subset of all possible DIS 2.0.4 enumerations were used; these were based on entities with which AL/HRA was expected to interact. Also, simulation management enumerations were not implemented since they are expected to change significantly in the next version and are only used locally without affecting any other sites.

Digital Voice Communication

All voice communication was digitized and sent out over the WF95 network using DIS voice packets. This not only includes communication among aircrews and controllers, but also all exercise control/management communication. Due to difficulties with integrating our existing communication system with the one used for WF95, we had limited voice communication throughout the TIE.

As technical lead, TACCSF provided digital voice systems from a company called TSI for use during WF95. These TSI systems were leftovers from a previous exercise, and TACCSF decided to use them because there were available and they had experience using them. Though the TSI systems worked for TACCSF, they caused many problems at other sites (including AL/HRA), and a tremendous amount of effort was required to achieve basic communication among sites in time for the TIE.

We had many problems trying to integrate the TSI system with our existing digital voice system. One problem was the TSI system ignores the frequency bandwidth field. It required the radio frequency be entered with 1 Hertz (Hz) precision, or it would block the transmission. Since the F-16 WSTs use the same radio interface as in the actual aircraft, pilots were only able to enter frequencies with a precision of 10,000 Hz. Our communication software needed to be modified to enable the TSI system to send and receive our transmissions.

Another problem was the TSI system required fixed-length data packets. The DIS standard voice packet has a field indicating the length of the packet; this allows for variable-length packets. Since the TSI system did not adhere to the standard, we had to modify our communication system to ensure the packets were the same length as those used by the TSI system.

After correcting those problems, we could then interoperate with the TSI system. However, in an attempt to fix numerous voice problems at other sites, TACCSF upgraded the TSI system software just two weeks before the TIE took place. This software upgrade fixed some problems, but it created new ones for AL/HRA. The new software ignored data packets that did not calculate checksums for error checking. This is not a requirement of DIS, and it is optional, in general, for most network communications. Most real-time operating systems (including the one used for voice communication at AL/HRA) do not calculate checksums because they must meet strict processing deadlines.

As a result of the late TSI system software change, we were unable to fully integrate our voice system with the TSI system. The pilots in both cockpits and the technicians and managers at the MSS could receive transmissions from any voice channel, but the lead pilot was the only person who could send out voice transmissions. Obviously, this is not an ideal situation since it was difficult for the program manager at the MSS to talk on the exercise control voice channel during the TIE. The program manager would have to walk over to the lead cockpit, take the headset from the pilot, and then speak. Fortunately, two-way conversation on the exercise control channel was

minimal during the TIE, and the limitations of the voice communication system did not significantly impact mission accomplishment.

Database Development

Since the WF95 scenario was based in Korea, we needed to develop a Korean database for our image generator in order to provide appropriate visual cues to the pilots. Technicians used Defense Mapping Agency (DMA) Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD) to develop the database for the Advanced Visual Technology System (AVTS) image generator used at AL/HRA. Additional models were placed in the database at specific target areas defined by the WF95 scenario.

DMA DTED was also used for the Terrain Interface Unit (TIU). The TIU compensates for database correlation differences by clamping ground vehicles generated at other sites to the AVTS terrain skin. This prevents ground vehicles from appearing to float above or sink below the visual terrain as a result of differing levels of terrain fidelity at each site. The TIU simply ignores the elevation data provided by a ground vehicle and instead uses the elevation data from the AVTS database for that location. This ensures that the pilot's out-the-window visual display correctly shows ground vehicles on the ground.

Testing

The testing and systems integration process was not nearly as effective as it could have been. Problems with sites not complying with the DIS standard, problems with handling the large amount of network traffic, and problems with communication and coordination should have been corrected early in the test period. Instead, many of these problems recurred during the two-day TIE. Part of the reason for the ineffective use of testing is due to the complexities of managing and coordinating nine different sites distributed across the country. Also, a lot of the testing focused on completing development of the Battlestaff Training School's Air Warfare Simulation (AWSIM).

AWSIM provided the majority of the scenario's constructive entities, so it was an important part of the testing process. However, problems with AWSIM development received a disproportionate amount of attention from test management. Other problems among the remaining sites were often overlooked and, as a result, never addressed. The following paragraphs summarize AL/HRA's observations of WF95 testing activities.

TACCSF, the WF95 technical lead, scheduled DIS compliance testing for each site individually before connecting different sites together. This was a good plan since individual testing leaves no ambiguity about the source of strange data on the network. Though the plan was good, its execution was flawed. AL/HRA was one of the first sites scheduled for DIS compliance testing. After about an hour of testing, TACCSF reported our simulation data was good, but we at Armstrong Laboratory could not see any of their simulation entities. The reason for this was that TACCSF was using DIS standard 2.0.3 instead of 2.0.4. After we notified TACCSF they were using the wrong version of DIS, they canceled the remaining compliance testing. It was never rescheduled because shortly thereafter testing of multiple sites began.

The lack of thorough DIS compliance testing significantly hindered system integration testing. Once the network is loaded with a thousand or more entities, it is difficult to isolate the cause of any problems that arise. We saw numerous incidents of noncompliance with the DIS standard throughout the test period and even during the TIE. Examples of observed noncompliance include:

1. **Bad Protocol Data Unit (PDU) Information**. Simulation applications use PDUs to provide information about their entities to other simulation applications on the network. Many times during WF95 we saw PDUs containing bad data. When other sites used wrong country identifier codes or used invalid values in the pitch orientation field, our systems slowed down (sometimes significantly) attempting to process this bad data.

2. **Unidentified Entities**. Hundreds of unidentified ground vehicles were on the network during the TIE. These entities used enumerations that were not defined in the DIS 2.0.4 standard or in the WF95 enumeration list.

3. **Improper Update Rates**. The DIS standard specifies that entities should update their position every five seconds, unless they exceed the threshold of the dead-

reckoning algorithm, in which case they should update more frequently. We saw many violations of this. Hundreds of nonmoving ground vehicles would update their position every second, putting unnecessary traffic on an already overburdened network. Some aircraft entities jumped hundreds of meters with each update. We could not determine if this was caused by slow update rates or improper dead-reckoning because their timestamps were not updated correctly.

4. Damage Assessment. The DIS standard states the targeted entity determines the amount of damage it receives during an attack. For example, if a MiG-29 shoots a missile at an F-15, the F-15 determines the amount of damage caused by that missile. This principle was also violated during WF95. When AL/HRA F-16s flew near a TACCSF Patriot missile battery, the planes would suddenly disappear from TACCSF's displays. We never saw a missile launch on the network, though TACCSF said it had fired a missile. After much thought, we determined that the Patriot simulation decided it had killed the F-16 and removed it from their displays. According to DIS, our F-16 should have determined it was killed by the missile and then notified every one on the network that it was dead.

5. Experimental PDU. TACCSF used an experimental PDU not defined in DIS 2.0.4. The Identification Friend or Foe (IFF) PDU was used extensively by its AWACS simulator and the Patriot simulator. We did not know the implementation of the IFF PDU was a WF95 requirement until the last week of testing. As a result, we were not able to fully interoperate with some of TACCSF's simulations.

In addition to spending a lot of testing time dealing with bad data, we also had problems with too much data. During testing and the TIE, there were usually between 1,000 and 1,200 entities on the network at any one time, and this high traffic load caused some problems for our systems. The F-16 WST had occasional system failures during testing until we modified our method of filtering out entities by range. The MSS could only process the first 300 entities it received, and even after modifying the filtering algorithm, we still were not able to get reliable god's-eye displays of the ongoing WF95 scenario. The amount of traffic would sometimes slow down the MSS so badly that we

would have to disconnect it from the wide-area network in order to reinitialize the F-16 WSTs.

Technical difficulties were not the only cause for frustration during testing. Test communication and coordination proved difficult. This was primarily a result of the unreliable digital voice communication system. For much of the test period, we were unable to communicate using digital voice, and we therefore had to rely on the phone. Often, the phone at TACCSF would be busy for long periods or else no one would answer. This resulted in many hours where we at AL/HRA would not have any idea what was going on. This inefficiency could have been eliminated if we had used a telephone conference call among all testing sites for test coordination.

Mission Summaries

The WF95 scenario was based on a Korean scenario used for a previous Blue Flag exercise. AL/HRA pilots were scheduled to fly a variety of missions, including air interdiction, close air support, and search-and-rescue (SAR). The F-16s were loaded with Mk-82 bombs, AIM-9 missiles, and AIM-120 missiles. All AL/HRA missions originated at Suwon Air Base in South Korea; the missions took place over North Korea. For all missions, the pilots were under control of the AWACS operators located at TACCSF.

AL/HRA flew the same three missions for both days of the TIE. As is shown in the following paragraphs which detail each mission flown on 5 Dec 95, the actual mission flown differed significantly from the original plan. This was primarily a result of poor exercise control and some technical problems.

First Mission

The original plan was for the AL/HRA F-16s to fly an interdiction mission and then get re-roled to support a SAR operation. The mission started late due to problems with TACCSF's gateway. Once shown on the AWACS display, our F-16s were vectored to various air threats which were engaged. The F-16s shot down several MiGs that were

generated at TACCSF. The F-16s were never re-roled to SAR, and they simply flew around hostile territory and engaged whatever came near.

Second Mission

This mission was scheduled as close air support. Once the F-16s were airborne, AWACS advised that we would be engaging air threats, not ground targets. The F-16s flew around and engaged some threats, but the TACCSF gateway went down again, and the mission was cut short.

Third Mission

The third mission called for AL/HRA to play an air interdiction role as part of a joint strike package. The start of the mission was delayed about 40 minutes due to TACCSF gateway problems. The F-16s then flew to the target under AWACS control and dropped bombs on target. We had no escort. It was never explained where the other members of the strike package were. After coming off target, AWACS vectored us to several air threats which we engaged and shot down.

LESSONS LEARNED

Though the WF95 TIE accomplished its objectives, it is obvious that there is room for improvement in the way advanced distributed simulation exercises are currently executed. Some of the lessons learned (or reinforced) by AL/HRA's participation in WF95 are listed in the following paragraphs.

1. **Focus on training, not technology**. To date, the majority of distributed simulation exercises, including the WF95 TIE, have focused on creating a synthetic environment that is as complex as technically possible. While this is useful in that it advances the technological state of the art, we must remember the ultimate purpose of this technology is to provide meaningful training. Simulation exercise requirements should be based on real-world training requirements, not technical goals. The full

training potential of ADS technology will not be realized until exercises use clearly stated operational training requirements as their foundation. It is obvious from reading the summaries of AL/HRA's WF95 missions that our F-16 pilots received no useful training.

2. Ensure DIS compliance. Each simulation system should complete DIS compliance testing before being integrated with the other sites, and the test director must make sure there is ample time in the schedule to complete DIS testing activities before the exercise begins. The time spent testing each system or site individually before integration more than pays for itself by immensely reducing the effort required to troubleshoot any problems. Without thorough DIS compliance testing, you can expect to have system crashes, unknown entities, jumping entities, and unpredictable network loading. The test director should ensure that each individual simulation system is correctly sending and interpreting all entity types used for the exercise. Test engineers should collect and analyze network data throughout the testing period and report discrepancies to the test director.

3. Exercise control. The distributed nature of exercises like WF95 makes exercise control difficult. Despite its difficulty, however, it is crucial that communications for testing and scenario execution are reliable or else individual sites will be lost in a fog of uncertainty. A telephone conference call should be used for test coordination and exercise control, at least until the digital voice communication network is reliable at all sites. The exercise director should also use a roll call to announce important events. Going through the site list one by one to make sure everyone is listening ensures all sites get the word. There is also a need for better management of scenario execution. Someone should track each mission and notify others when their mission is impacted by a change or loss of another's mission. This is important when sites are dropping on and off the network. During WF95, we had no escort on our strike package mission. No one knew where our escort was or why they were not there. Proper scenario management reduces the likelihood of situations like that.

CONCLUSION

The WF95 TIE resulted in several significant technological achievements, including upgrading the AWSIM constructive simulation to be compatible with DIS protocols and stimulating live C2 equipment with simulation data. In addition, all participating sites gained valuable experience in the complexities of putting together an advanced distributed simulation exercise. These accomplishments will help make future simulation exercises more realistic and useful.

However, it is important to note that WF95 did not provide any significant training to any of the system operators -- it merely demonstrated a tremendous training potential. To realize the full potential of this technology, future distributed simulation efforts must be based on operational training requirements, not technical goals.

Appendix A. Chronology

12 Jul 95	Notified of AL/HRA participation in WF95
26-28 Jul 95	Initial Planning Conference (Hurlburt Field, FL)
6-7 Sep 95	Final Planning Conference (Hurlburt Field, FL)
18-19 Oct 95	In-Progress Review (Kirtland AFB, NM)
9-10 Nov 95	Testing
17 Nov 95	Testing
20-22 Nov 95	Testing
27 Nov - 1 Dec 95	Testing
4-5 Dec 95	WF95 TIE

Appendix B. Acronyms

ACC	Air Combat Command
ADS	Advanced Distributed Simulation
AFB	Air Force Base
AL/HRA	Armstrong Laboratory, Aircrew Training Research Division
AVTB	Aviation Test Bed
AVTS	Advanced Visual Technology System
AWACS	Airborne Warning and Control System
AWSIM	Air Warfare Simulation
BTS	Battlestaff Training School
CRC	Control and Reporting Center
C2	Command and Control
DART	Display for Advanced Research and Technology
DFAD	Digital Feature Analysis Data
DIS	Distributed Interactive Simulation
DMA	Defense Mapping Agency
DSI	Defense Simulation Internet
DTED	Digital Terrain Elevation Data
IFF	Identification Friend or Foe
IWC	Information Warfare Center
JAOC	Joint Air Operations Center
JFACC	Joint Force Air Component Commander
JSTARS	Joint Surveillance Target Attack Radar System
MSS	Multiship Support Station
NIU	Network Interface Unit
PDU	Protocol Data Unit
RAJPO	Range Application Joint Program Office

SAR	Search and Rescue
TACCSF	Theater Air Command and Control Simulation Facility
TADIL	Tactical Digital Information Link
TBA	Theater Battle Arena
TIBS	Tactical Information Broadcast System
TIE	Technical Integration Evaluation
TIU	Terrain Interface Unit
WF95	Warfighter95
WISSARD	What-If Simulation Systems for Advanced Research Development
WST	Weapon System Trainer